
Lozania nunkui (Lacistemataceae), a New Species from the Sandstone Plateaus of the Cordillera del Cóndor in Ecuador and Peru

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ABSTRACT. *Lozania nunkui* D. A. Neill & Asanza (Lacistemataceae), a new species from the Cordillera del Cóndor region of southeastern Ecuador and adjacent northern Peru, is described and illustrated. It is distinguished from other species in the genus by the glabrous, entire, relatively thick and coriaceous, sclerophyllous leaves, and uniquely, by the five or occasionally six sepals, rather than four sepals as in all other known species. The new species is restricted to nutrient-poor, highly acidic sandstone plateaus within its range, and the thick sclerophyllous leaves appear to be an ecological adaptation to that edaphic condition.

RESUMEN. Se describe y se ilustra *Lozania nunkui* D. A. Neill & Asanza (Lacistemataceae), una nueva especie de la región de la Cordillera del Cóndor en el sureste del Ecuador y la zona colindante del norte de Perú. Se distingue de las demás especies del género por las hojas glabras, enteras, relativamente gruesas, coriáceas y esclerófilas, y por los cinco u ocasionalmente seis sépalos, en vez de los cuatro sépalos que presentan todas las demás especies. Dentro de su rango geográfico, la especie nueva está restringida a las mesetas de areniscas, con suelos pobres en nutrientes y muy ácidos, y las hojas gruesas y esclerófilas parecen ser una adaptación ecológica a esa condición edáfica.

Key words: Ecuador, IUCN Red List, Lacistemataceae, *Lozania*, Peru.

Lozania Mutis ex Caldas (Lacistemataceae) is a small Neotropical genus of just four accepted species at present (Sleumer, 1980; Gentry, 1988), with a distribution including southern Central America (southeast Nicaragua to Panama), the tropical Andes (Venezuela to Bolivia), and western Amazonia, including Amazonas, Brazil. All known species are small trees, sometimes shrubby, occurring in the understory of mature-phase moist and wet forests up to ca. 2400 m elevation.

In the Cordillera del Cóndor region of southeastern Ecuador and northern Peru, floristic inventory work in recent years has resulted in collections of a

number of undescribed species of trees and shrubs in various genera and families (Neill, 2005; Daly et al., 2012). Most of these undescribed taxa are evidently restricted to the outcrops of Cretaceous sandstone of the Hollín Formation, which constitute about 20% of the land area in the Cordillera del Cóndor region. Some of these substrate-restricted species exhibit morphological features that appear to reflect an ecological adaptation to the highly acidic, nutrient-poor soils that are derived from the sandstone substrate, frequently including glabrous, thick, coriaceous or sclerophyllous leaves. Among these novelties that are evidently local endemics on the sandstone plateaus of the Cordillera del Cóndor, is a species of *Lozania* that we and our colleagues have found on several sandstone outcrops in the region.

Lozania nunkui D. A. Neill & Asanza, sp. nov.

TYPE: Ecuador. Morona-Santiago: Limón-Indanza, Cordillera del Cóndor, Centro Shuar Kuankus, summit of Cerro Chuank Naint ("Vulture Mountain" in Shuar), a sandstone massif, 1270 m, 3°3'36"S, 78°14'25"W, 18 Sep. 2005 (fl., fr.), D. Neill, M. Asanza, W. Quizhpe & C. Morales 14657 (holotype, QCNE; isotypes, AAU, GB, HUT, K, LOJA, MO, NY, US).

Haec species a congeneris foliis satis crassis coriaceisque glabris nitidis integris venatione secundaria tertiariaque prominula atque sepalis 5 vel 6 (nec 4) distinguitur.

Tree attaining 10 m in height with trunk ca. 10 cm diam.; branches glabrous, mostly borne horizontally. Leaves elliptic to elliptic-obovate, broadly obtuse to shortly acuminate at apex, cuneate at base, coriaceous, rather thick, stiff and sclerophyllous, completely glabrous above and below, or glabrescent with a few scattered simple unicellular hairs on the lower surface, with entire margins, the blade (4–)5–10(–11) × (2.5–)3–5 cm, petiole 7–9 mm, glabrous or with a few strigose hairs; leaf surface lustrous, conspicuously glossy on upper surface, somewhat duller beneath, costa impressed above, prominent below; lateral nerves 4 to 7, curved ascending, secondary

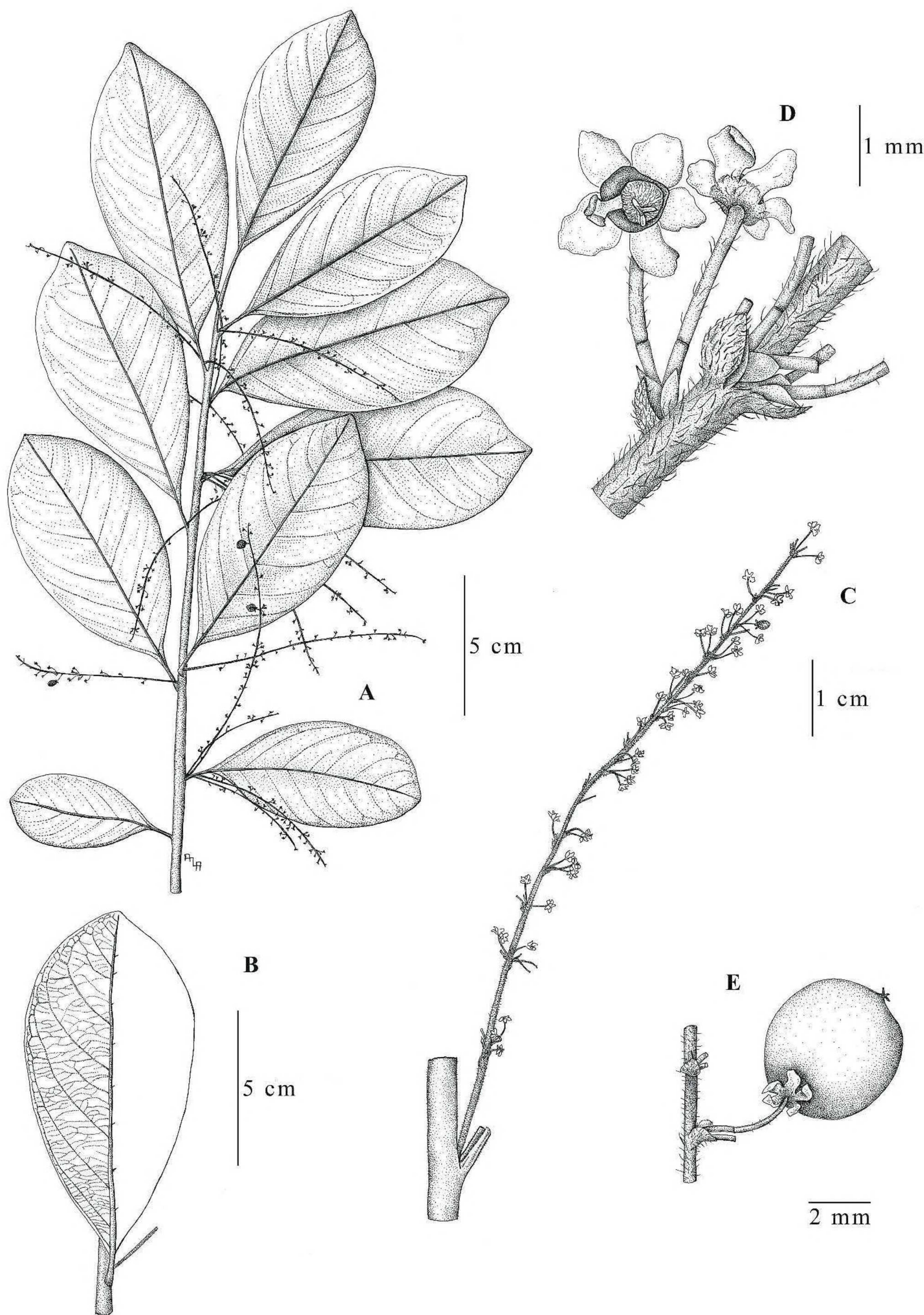


Figure 1. *Lozania nunkui* D. A. Neill & Asanza. —A. Flowering branch. —B. Leaf. —C. Inflorescence. —D. Flower. —E. Fruit. Drawn from the type collection D. Neill, M. Asanza, W. Quizhpe & C. Morales 14657.

and tertiary veins prominulous on both surfaces of blade. Inflorescence of axillary racemes, borne on leafy branches, or at nodes where leaves have fallen, on bare branches below leaves, usually 2 or 3 racemes per node, sometimes solitary. Inflorescences 6–10 cm, with strigose hairs on rachis; basal bract with strigose pubescence, obtuse at apex, ca. 0.5 mm, covering the smaller 2 glabrous bracteoles; flowers usually 3 at each node along rachis, with 1–4 mm between nodes along axis of inflorescence; pedicels ca. 2 mm, glabrous, articulate near base; sepals 5 or sometimes 6, broadly spreading, slightly reflexed at anthesis, obovate, obtuse to rounded at apex, ca. 0.8×0.6 mm, pale yellow when fresh; petals absent; basal disk annular, rather thick and fleshy; stamen 1, inserted at base of ovary within disk, filament ca. 0.3 mm, rather thick and stout; the 2 anthers forming an obtuse angle at apex of filament; ovary densely strigose-pubescent at anthesis, oblate, ca. 0.5×0.4 mm, the blunt apex with 3 reflexed style branches ca. 0.2 mm. Fruit ellipsoid-trigonous, 4–5 mm long and broad, with sparse strigose pubescence or becoming glabrescent, dark purple when ripe, fleshy; seeds usually 2 or 3 per fruit, ca. 3×2 mm, with fleshy red-orange sarcotesta.

Distribution and ecology. *Lozania nunkui* has a known geographical range restricted to the sub-Andean cordilleras east of the Eastern Cordillera of the Andes, in the Cordillera del Cóndor of Morona Santiago and Zamora Chinchipe provinces, Ecuador, and in Cajamarca Department, Peru, in an altitudinal range of ca. 1000–1700 m, from ca. $3^{\circ}00'S$ to $5^{\circ}10'S$ latitude. The only record from Peru was collected in the sub-Andean range known locally as the Cordillera Huarango; this north- to south-trending ridge forms the border between Cajamarca and Amazonas departments, and is actually a southern extension of the Cordillera del Cóndor that forms the Ecuador–Peru border from $3^{\circ}00'S$ to $4^{\circ}30'S$. The new taxon has not been recorded on the slopes of the Andes proper, nor in the Amazon lowlands below 1000 m.

All available evidence indicates that this species is ecologically restricted to sandstone or sandstone-derived soils. The known populations of this species all occur on the fragmented sandstone plateaus of the Cretaceous Hollín Formation in the Cordillera del Cóndor region, or on ridges or slopes immediately below the sandstone plateaus, where the soils have a relatively high sand content due to erosion from the sandstone formation above. These highly acidic, oligotrophic soils typically have a pH of about 3.8–4.5, with very low concentrations of N, P, and K and relatively high concentrations of Al and sometimes Fe (D. Neill, unpublished). Typically, the vegetation on

such substrates is a relatively low, dense forest, with a dense root mat and thick accumulation of humus. Thick sclerophyllous leaves or leaflets are characteristic of many other trees and shrubs on the sandstone plateaus of the Cordillera del Cóndor as well as the vegetation on white sands in lowland Amazonia (Anderson, 1981). The adaptive significance of sclerophylly remains controversial, and three main hypotheses are current: (1) resistance to drought and seasonal water deficits; (2) adaptation to low-nutrient soils; and (3) enhancement of leaf protection, particularly protection from herbivory (Turner, 1994; Edwards et al., 2000). These adaptive explanations for sclerophylly are not necessarily mutually exclusive. Fine et al. (2004, 2006) conducted reciprocal transplants of white-sand specialists and clay-soil species near Iquitos, Peru, and the experimental results suggest that sclerophylly or leaf toughness, as well as other traits such as increased levels of terpenes or tannins in leaf tissue often found in white-sand specialist species, confer significant protection from herbivores and a significant increase in fitness of white-sand specialist species in their special habitat. With the low nutrient levels in the soil and consequently very slow growth of plants on oligotrophic sandstone or white-sand substrates, the plant's investment to avoid loss of photosynthetic tissue through herbivory is evidently worth the cost.

Given that *Lozania nunkui* is a local endemic restricted to sandstone, and with remarkably more sclerophyllous leaves than its relatives, one may hypothesize that this species evolved in situ from an Andean ancestor within the genus *Lozania* and acquired these traits as an ecological adaptation to the nutrient-poor sandstone substrate. The sandstone plateaus have been available for colonization by plants, concomitant with the geologically recent uplift of the Andes and the erosion of the sediments overlying the Hollín sandstone formation, only in the past 3 to 4 million years (Gregory-Wodzicki, 2000). Because the sandstone plateaus of the Cordillera del Cóndor region are fragmentary and do not comprise a continuous surface, this species has evidently dispersed among the isolated sandstone outcrops over a distance of 250 km from north to south. Future phylogenetic work on *Lozania* may be able to confirm this hypothesis.

IUCN Red List category. *Lozania nunkui* has not been found in any formally protected area in Ecuador or Peru. The discontinuous populations on the several sandstone plateaus where it occurs in the Cordillera del Cóndor region are, in general, not imminently threatened by deforestation or habitat destruction. This may change if mining and other development

activities in the region are considerably expanded and do not take appropriate measures to mitigate their environmental impacts. More long-term impacts such as future climate change could threaten these small, scattered populations. According to the IUCN Red List criteria for estimated range, area of occupancy, and population size, *L. nunkui* should be listed in the category NT or Nearly Threatened (IUCN, 2001).

Phenology. *Lozania nunkui* has been collected in flower in the months of March, April, May, September, and October, and in fruit during most of those months as well. In the aseasonal climate within a few degrees of the equator, the taxon may well flower intermittently throughout the year with no clear-cut phenological pattern, which, as we have observed for a number of years, is the case for many trees in the region.

Etymology. All of the Ecuadorian populations of *Lozania nunkui* are within the ancestral territory of the Shuar, an indigenous group in the Jivaroan language family that now numbers about 110,000 people in southeastern Ecuador. In traditional Shuar mythology, Nunkui, the name we have borrowed for the specific epithet, is the feminine manifestation of the divine spirit, the Shuar goddess of agriculture; in Shuar society, cultivation of subsistence crops in swidden gardens near the home, especially the staple *Manihot esculenta* Crantz, is the work of women. The name nunkui is also used for the regional association of Shuar communities, the Asociación Nunkui in the northern part of the Cordillera del Cóndor, in the watershed of the Río Coangos, where the first several collections of this species were made in 2005.

Discussion. *Lozania nunkui* shares some morphological features with *L. glabrata* A. H. Gentry, which is known only from the type collection from the Pacific coastal area of the Chocó Department, Colombia; both species have glabrous leaves with entire to subentire margins. The other three species of *Lozania*, *L. klugii* (Mansf.) Mansf. from western Amazonia, *L. mutisiana* Schult. from Nicaragua to Bolivia, and *L. pittieri* (S. F. Blake) L. B. Sm. from Nicaragua to Colombia and Venezuela, have leaves that are pubescent beneath with serrulate margins. The leaves of *L. glabrata*, however, are relatively thin and membranaceous, whereas those of *L. nunkui* are considerably thicker, stiff and coriaceous, and sclerophyllous. In *L. glabrata*, uniquely, the staminal filament is split at the apex, separating the two anthers; this feature is not shared with *L. nunkui*. The two glabrous-leaved species are also similar in having

the longest inflorescences in the genus, to ca. 10 cm, whereas the remaining three species have inflorescences usually shorter than 6 cm.

Most strikingly, *Lozania nunkui* differs from all other known species in the genus in the number of sepals. All other species have flowers with just four sepals, and this was considered a diagnostic feature of *Lozania* in Sleumer's (1980) monograph that included *Lozania* and *Lacistema* Sw. in Flacourtiaceae. Flowering specimens of *L. nunkui*, however, have five sepals, with occasional flowers in some collections having a sixth sepal. All other morphological features indicate that this species belongs in the genus *Lozania*, but the presence of five (or rarely six) rather than four sepals requires a slight modification of the diagnostic identity of the genus. We have found only one exception to the presence of four sepals in other species of *Lozania*: a collection of *L. klugii* from Miazzi in the upper Río Nangaritza watershed of Zamora Chinchipe Province, Ecuador, within the Cordillera del Cóndor region, *J. Jaramillo 14155* (NY, QCA), which has flowers with four sepals and five sepals in the same inflorescence. This specimen was collected in an area where *L. nunkui* also occurs and may represent a case of introgression or hybridization between the two species, but does not share any of the diagnostic morphological features of *L. nunkui* except for sepal number in some of the flowers; the leaves are serrulate and pubescent beneath, and the inflorescence is relatively short as in typical *L. klugii*.

Paratypes. ECUADOR. **Morona Santiago:** Cantón Limón-Indanza, Cordillera del Cóndor, Centro Shuar Warints, 1020 m, 3°09'16"S, 78°14'50"W, 5 Oct. 2002 (fl.), *C. Kajekai 10* (MO, QCNE); Cerro Maka Naint, 1600 m, 3°10'59"S, 78°17'57"W, 7 Oct. 2002 (fl.), *T. Katan 25* (MO, QCNE); Centro Shuar Kuankus, cumbre del Cerro Chuank Naint, 1250 m, 03°03'40"S, 78°14'21"W, 19 June 2005 (fl.), *T. Katan 318* (MO, QCNE); Centro Shuar Yunkumas, Cerro Chuank Naint, collections made near 1-hectare forest inventory plot, 1150 m, 3°03'34"S, 78°14'45"W, 17 Sep. 2005 (fl.), *D. Neill & NSF Dendrology Course 14632* (MO, QCNE), *14812* (MO, QCNE), *14822* (MO, QCNE); Cerro Chuank Naint, 1130 m, 3°03'31"S, 78°14'48"W, 19 Dec. 2005 (fl.), *A. Wisum 318* (MO, QCNE), 1150 m, 19 Dec. 2005 (fl.), *C. Morales 1579* (MO, QCNE), 20 Dec. 2005 (fl.), *C. Kajekai 256* (MO, QCNE). **Zamora Chinchipe:** Cantón El Pangui, Cordillera del Cóndor, Cuenca alta del Río Wawaime, afluyente del Río Quimi, 1500 m, 3°35'06"S, 78°26'18"W, 28 Sep. 2006 (fl.), *W. Quizhpe 2319* (LOJA, MO, QCNE); 1660 m, 3°35'17"S, 78°26'16"W, 30 Sep. 2006 (fr.), *W. Quizhpe & A. Wisum 2385* (LOJA, MO, QCNE); 1400–1600 m, 3°34'11"S, 78°25'38"W, 23 Oct. 2006 (fl.), *H. van der Werff & W. Quizhpe 21633* (MO, QCNE); 1510 m, 3°34'05"S, 78°26'22"W, 2 Apr. 2007 (fl.), *C. Kajekai 1196* (MO, QCNE); Contrafuerte Tres Patines, S of Río Tundayme, above the military rd. to Cóndor Mirador, 1680 m, 3°37'49"S, 78°26'50"W, 23 Sep. 2007 (fl.), *D. Neill, C.*

Davidson & S. Christoph 15951 (LOJA, MO, QCNE); Cantón Yantzaza, 1 km N of Río Machinaza at Las Peñas, ridgetop with Hollín sandstone substrate, 1640 m, 3°46'33"S, 78°29'46"W, 20 Mar. 2008 (fls.), *D. Neill & W. Quizhpe 16253* (LOJA, MO, QCNE); Cantón Nangaritza, upper Río Nangaritza, Area de Conservación Los Tepuyes, on upper portion of sloping sandstone plateau SW of Las Orquídeas, in & near 1-hectare forest inventory plot, 1620 m, 4°15'32"S, 78°41'04"W, 6 Nov. 2006 (fl.), *D. Neill & NSF Dendrology Course 15431* (LOJA, MO, QCNE). PERU. **Cajamarca:** San Ignacio, Distr. Huarango, poblado Huarandoza, caserío El Edén, camino al cerro de arena blanca, bosque enano, 1697 m, 5°10'37"S, 78°44'27"W, 23 May 2007 (fl., fr.), *J. Perea & V. Flores 3259* (MO, USM).

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